

CLAIMS

1/ A device for diffusing calibrated small volumes or drops (G) of at least one liquid, the device being of the type comprising:

5 · at least one displacement path, (C, C1, C2, C3) for the liquid defined by a series of pairs of close-together surfaces (4a-4b, 6a-6b, ..., 14a-14b) enabling the liquid to be retained and to be moved from one pair of surfaces to another; and

10 · means for applying an electric field between the pairs of surfaces in order to move the liquid from one pair of surfaces to another;

the device being characterized in that:

15 · the series of pairs of close-together surfaces (4a-4b, 6a-6b, ..., 14a-14b) defining at least one displacement path co-operate to store the liquid, to form drops of liquid, and to move liquid drops to an outlet from said path leading towards a drop destination site; and

20 · the means for applying an electric field apply a determined sequence of electric fields between the pairs of close-together surfaces so as to form drops of liquid from the liquid storage and so as to move and mix the drops to the drop outlet of said path. ^{apply} _{with dual}

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2/ A device according to claim 1, characterized in that said liquid is a liquid containing an active principle intended (in particular) for applications in generating odors, in cosmetics, in medical treatments, in hygiene, 30 in chemistry, or in medical analysis.

3/ A device according to claim 2, characterized in that said liquid contains at least one essential oil and/or a pheromone.

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4/ A device according to claim 1, characterized in that the outlet for drops from the displacement path leads to the outside of the device.

5 5/ A device according to claim 1, characterized in that the outlet for drops from the displacement path leads to a destination site situated within the device.

10 6/ A device according to claim 4, characterized in that the outlet for drops is formed by at least one orifice putting the device into communication with the outside (30), said orifice having at least one electro-osmosis electrode or at least one heating resistance to accelerate the evaporation of liquids at such points.

15 7/ A device according to claim 1, characterized in that said electric field application means comprise an electrode associated with at least one surface in each pair of close-together surfaces (4a-4b, 6a-6b, ..., 14a-
20 14b).

25 *Sub* 8/ A device according to claim 1 or claim 7, characterized in that said surfaces (4a-4b, 6a-6b, ..., 14a-14b) present wettability that is controlled by surface treatment.

30 9/ A device according to any one of claims 1 to 8, characterized in that at least one of the two faces of a pair of surfaces (4a-4b, 6a-6b, ..., 14a-14b) is carried by a structure in the form of a mesa (22a, 22b) formed on its respective substrate (2a, 2b), said mesa-forming structure causing said surfaces to be closer together than the respective substrates, so that capillarity maintains the liquid selectively in the zones where the
35 faces are closer together.

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Sub 10/ A device according to any one of claims 1 to 9,
characterized in that the two faces of a pair of surfaces
(4a-4b, 6a-6b, ..., 14a-14b) are substantially parallel.

5 11/ A device according to any one of claims 1 to 10,
characterized in that the two faces of a pair of surfaces
form between them a small angle (α), thus creating a zone
towards one edge of said faces (4-1, 6-1) that is closer
together than an opposite zone (4-2, 6-2), thus enabling
10 liquid to be entrained by capillarity towards said
closer-together zone.

12/ A device according to claim 11, characterized in
that, for a pair of surfaces, said closer-together zone
15 is situated at the edge which is closer to the
destination site for the displaced liquid.

Sub 20 13/ A device according to any one of claims 1 to 10,
characterized in that at least one of the pairs of close-
together surfaces presents a plurality of planes (4a',
4a'') so as to create a plurality of different spacings
(e1, e2) between said close-together surfaces.

14/ A device according to claim 13, characterized in that
25 the or each pair of electrodes presenting a plurality of
planes (4a', 4a'') is arranged so that the close-together
spacing is situated downstream relative to the liquid
displacement direction.

30 Sub 13 15/ A device according to any one of claims 1 to 14,
characterized in that at least one pair of close-together
surfaces (4a, 4b) forms at least one reservoir, a
separation pad (6a, 6b), and a pad (8a, 8b) for forming a
small drop of liquid, co-operating to constitute an
35 extractor for said small volume.

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Sub 16/ A device according to claim 1 or claim 15,
 03 characterized in that said reservoir (4a, 4b) comprises a
 confinement volume operating by capillary action and
 interface tension between two close-together surfaces, at
 5 least one sector of the periphery of a liquid-retaining
 zone constituting extractor-forming means and at least
 one face of the retaining zone being connected to liquid
 feed means.

10 17/ A device according to claim 16, characterized in that
 the extractor is constituted by a liquid-retaining zone
 adjacent to a reservoir and is implemented by two close-
 together parallel faces so as to produce capillary and
 surface tension action between them, said surface being
 15 provided with electrodes enabling an electric field to be
 created in said zone to extract calibrated quantities of
 liquid from the reservoir (4a, 4b), the width of said
 zone relative to the liquid displacement axis being
 substantially smaller than its length and more
 20 substantially smaller both than the width of the
 reservoir to which it is connected and that the width of
 the close-together surfaces of the displacement path for
 moving calibrated volumes of liquid to which it is
 connected.

25 18/ A device according to any one of claims 1 to 17,
 characterized in that the displacement path (18-1, 18-2,
 18-3) for moving calibrated volumes of liquid is
 constituted by a zone for retaining liquid by capillary
 30 and surface tension action between two close-together
 faces, such that the width of said retaining zone
 relative to the displacement path axis is of a dimension
 that is substantially greater than that of the extractor
 to which it is connected, the faces forming said zone
 35 being provided with electrodes that enable a
 distributable electric field to be created for receiving

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at least one calibrated quantity of liquid extracted from the reservoir by the action of the extractor.

19/ A device according to any one of claims 1 to 18,
5 characterized in that it is made up of at least two displacement paths (18-1, 18-2) enabling calibrated quantities 1, 2, 3, ..., N of liquids to be extracted from at least two reservoirs and conveyed towards at least one other path internal to the device, the
10 calibrated quantities 1 to N not necessarily having the same volume.

20/ A device according to claim 1, characterized in that at least one reservoir (4a, 4b) can be put into
15 communication with the outside of the device so that liquid can be caused to penetrate therein.

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21/ A device according to any one of claims 1 to 20,
20 characterized in that it comprises at least two reservoirs arranged in such a manner as to enable the calibrated small volumes extracted from said reservoirs to be combined and mixed together, and at least one displacement path for conveying them to a destination zone.

22/ A device according to any one of claims 1 to 20,
25 characterized in that the or each reservoir and each pair of close-together surfaces of said displacement path are configured to create relaxation of the perimeter of the liquid in the absence of an electric field so as to
30 facilitate the passage of said liquid from one pair of surfaces to another.

23/ A device according to any one of claims 1 to 22,
35 characterized in that at least one of the reservoirs contains a rinsing liquid suitable for cleaning the

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displacement path(s) for moving calibrated small volumes of liquid.

24/ A device according to any one of claims 1 to 23, characterized in that it is arranged to be fed from at least one extractable reservoir (42), said reservoir being in the form of a cartridge or the like, for example.

25/ An assembly for diffusing liquid in the form of small volumes, the assembly being characterized in that it integrates in a common package:

- at least one device (1) for forming, moving, and diffusing drops according to any one of claims 1 to 24;
- control electronics for generating electrical potentials (39, 46) for delivering control signals in programmable manner to the means for applying an electric field;
- at least one reservoir (4a, 4b) of liquid to be diffused; and
- an electrical power supply source (38), e.g. constituted by an optionally rechargeable battery.

26/ An assembly according to claim 25, characterized in that the package is substantially plane having the format of a smart card or a credit card.

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